



**ENVIRONMENTAL
TECHNOLOGY
BEST PRACTICE
PROGRAMME**

GG87
GUIDE



Be Solvent Wise

SOLVENT CONSUMPTION IN DRY-CLEANING



GOOD PRACTICE: Proven technology and techniques for profitable environmental improvement

SOLVENT CONSUMPTION IN DRY-CLEANING

This Good Practice Guide was produced by the
Environmental Technology Best Practice Programme

Prepared with assistance from:

Textile Services Association Limited



SUMMARY

This Good Practice Guide describes practical ways in which you can make more efficient use of dry-cleaning solvents such as perchloroethylene (perc). It also outlines the main health and safety requirements relating to solvent use in the dry-cleaning sector.

There are two important reasons why you should use solvents more efficiently:

- to minimise costs and increase your profits;
- to minimise your output of volatile organic compounds (VOCs); this will allow you to meet the requirements of the new legislation being introduced to reduce these emissions.

The best way of achieving efficient solvent use is to set up and implement a Solvent Management Programme. This involves monitoring consumption carefully week by week, setting appropriate targets for improvement, and implementing a range of good practice procedures that will allow solvent use to be minimised.

Typical measures for reducing solvent use include good machine and equipment operation, regular maintenance and attention to issues such as process programming and solvent delivery. You may also benefit from installing modern, closed-circuit dry-cleaning machines that minimise solvent handling and losses, or upgrading your existing machines by retrofitting free-standing carbon adsorption units.

Good equipment that has been properly installed is only one success factor. To benefit fully from your investment, ensure that staff are properly trained in the handling of solvents and the efficient operation of your dry-cleaning machines.

At the end of this Guide there is an Action Plan for you to follow. This will allow you to start reducing your solvent consumption - and save money - straight away!

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1.1 THE PURPOSE OF THIS GUIDE

The main purpose of this Good Practice Guide is to show you, as the manager of a dry-cleaning operation, how it is possible to clean more garments or textiles for every litre of solvent used. By adopting the good practice techniques and other measures described, you will immediately be on the road to improving your environmental performance and saving money. You will also be more likely to meet the requirements of future solvent emissions legislation.

The Guide also includes information on the health and safety requirements relating to your solvent use.

1.2 CURRENT CONCERNS IN THE DRY-CLEANING INDUSTRY

The dry-cleaning sector, in common with many other retail sectors, is under considerable commercial pressure to maintain its profit margins in a difficult economic climate. Any reduction in its costs, for instance by reducing solvent consumption, is therefore likely to improve profitability.

The second major issue facing the dry-cleaning sector relates to its use of solvents. Solvents have attracted the attention of legislators because of concerns about their likely effects on the environment. The manufacture of certain substances, including CFC113, has already been phased out under the Montreal Protocol because of their effect on the ozone layer.

Perchloroethylene (perc), which is by far the most popular dry-cleaning solvent, does not fall into this category. It has no significant effect on the ozone layer and will therefore continue to be available.

However, the solvents used in dry-cleaning (and in many other industries) are classed as volatile organic compounds (VOCs), and legislation is now being introduced to restrict the emission of VOCs to protect both human health and the environment. The most recent proposed EC Directive, dated November 1996, includes the following requirements:

- perc emissions should not be greater than 20 grams (g) solvent per kilogram (kg) of work processed (which can also be expressed as an emission level of 80 kg of work per litre of solvent);
- new machinery installed after the Directive has been adopted must comply immediately with its requirements and existing installations must comply by the year 2007.

It is clear that dry-cleaners will soon be required to reduce their solvent emissions to atmosphere to comply with environmental legislation on VOCs. If you take steps now to introduce effective solvent management, you will be showing a sensible and responsible attitude to the issue. You can significantly improve your environmental performance and reduce your operating costs by implementing good practice in terms of day-to-day operation and maintenance.

Controlling the amount of solvent you use has a major effect on the profitability of your dry-cleaning business. Furthermore, by increasing the efficiency of solvent use, you will make a positive contribution to the health and safety of your staff, reducing both the amount of solvent they handle and their exposure to solvent vapour.

Demonstration of solvent management is also likely to be a requirement under the forthcoming VOC Directive. The latest draft of this Directive requires companies using solvents to submit a Solvent Management Plan each year.



section
2

IDENTIFYING THE OPPORTUNITIES

Opportunities for improving solvent consumption, and thereby saving costs, can be identified at many stages in the dry-cleaning cycle:

- design of equipment;
- installation of equipment;
- solvent storage and handling;
- selecting a dry-cleaning process;
- machine operating practices;
- machine maintenance;
- solvent recovery.

This Guide covers each topic, showing you how to save solvent at each stage.

To get you started on your own Solvent Management Programme, this Section describes how you can measure your own solvent use and emissions. It also discusses other solvent management issues such as improving your equipment and procedures, the value of training and the importance of target setting.

You can find more general information on the benefits of solvent management in Good Practice Guide (GG13) *Cost-effective Solvent Management*. This free Guide, produced by the Environmental Technology Best Practice Programme, also suggests ways in which you can reduce the amount of solvent you use.

2.1 MEASURING SOLVENT USE AND EMISSIONS

You need to measure your solvent use if you are to manage solvents effectively and comply with the solvent emission limits laid down in the Directive.

Weekly records

You should begin by keeping accurate weekly records of solvent use. Appendix 1, which you can copy or adapt, is one example of the type of form you might use to calculate the weight of work you process per litre of solvent used. Using this form is a simple way to monitor the efficiency of your use of solvent and can be used to produce a weekly or monthly graph, like the one shown in Fig 1.

SOLVENT MANAGEMENT PLAN TRIALS

The form shown in Appendix 1 was completed every week for a month by several dry-cleaning companies to make sure that it was 'user-friendly'. Some of the results are shown in Table 1.

Week beginning Monday	Solvent volume in machine at beginning of week (litres)	Solvent added to machine during week (litres)	Solvent volume in machine at end of week (litres)	Solvent used during week (litres)	Weight of work processed during week (kg)	Weight of work per litre of solvent used, ie solvent performance (kg/litre)
	(A)	(B)	(C)	(D = A + B - C)	(E)	(F = E/D)
Unit A: Enclosed machine with refrigerated solvent recovery unit						
12 Oct	236	0	234	2	403.5	202
19 Oct	234	0	231	3	412	137
26 Oct	231	0	230	1	360	360
2 Nov	230	10	237	3	410	137
Unit B: Closed-circuit machine with carbon adsorption						
12 Oct	236	0	233	3	501	167
19 Oct	233	5	236	2	418	209
26 Oct	236	0	233	3	423	141
2 Nov	233	5	236	2	414	207

Table 1 Some results of the Solvent Management Plan trials

The values for the final column (weight of work per litre of solvent used) were then plotted on a graph (Fig 1). This shows very clearly that solvent performance varied widely. This performance is influenced by a number of factors - the type of machine used, the types of item cleaned and the machine load, all of which can vary significantly.

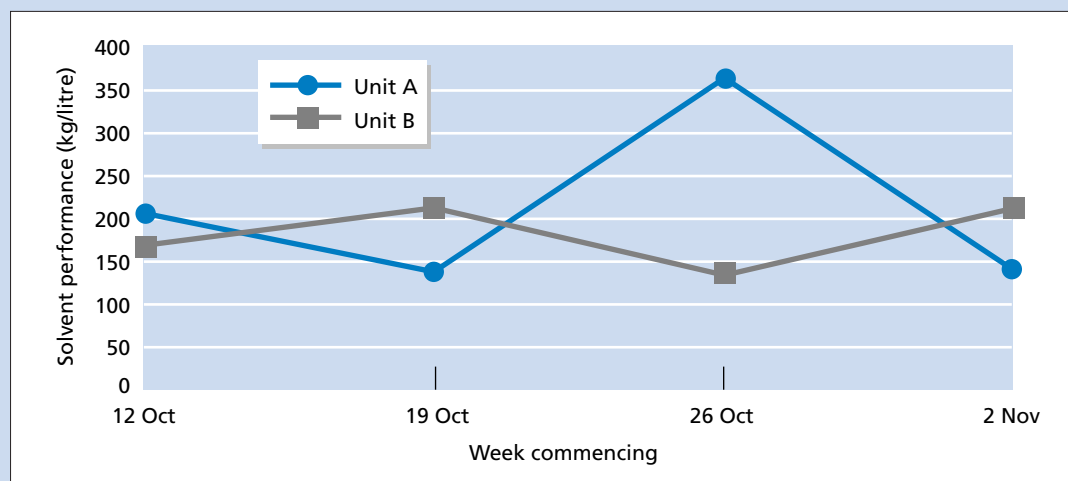


Fig 1 Solvent Management Plan trials: weight of work per litre of solvent used (kg/litre)

Those dry-cleaners who took part in the trials made the following comments:

'This is the first time I have taken a disciplined approach to managing solvent consumption.'

'As a result of this trial, I can see I need to take steps to reduce my solvent consumption.'

They felt that the trial had been valuable and that keeping solvent consumption under control would become increasingly important because of the escalating cost of the resources needed to run a dry-cleaning unit.

Monthly and annual records

To comply with the proposed VOC legislation, you will need to produce an annual return form or Solvent Management Plan. Appendix 2 shows a blank sample Solvent Management Plan, which you can copy for your own return form. By using this form, you will be able to calculate your actual solvent emission levels.

To complete the return form you will need to record the following information for each installation for a 12-month accounting period:

- The amount of solvent that you have in stock at the beginning of the period (Z).
- The weight (kg*) of solvent supplied for the installation over the same period (Y).
- The remaining solvent stock at the end of the period (X).
- The change (W) in solvent stock level (kg) over the period ($W = X - Z$). If your stock level has fallen, remember to record this as a negative value.
- The estimated weight of solvent (kg) in waste that you have sent for treatment or solvent recovery during the same 12-month period (V)**.

* The accepted norm for the industry is that 1 litre of perc weighs 1.6 kg. To convert from litres to kg, multiply by 1.6.

** Solvent disposed of to landfill is classified as an emission and should not be included in this figure.

You can now work out your total solvent emissions for the 12-month accounting period using the following equation:

$$U \text{ (total solvent emissions in kg)} = Y - W - V$$

You can work out your emission rate in grams of solvent per kg of work processed (g/kg) in one of two ways:

- Record the total number of loads processed during the 12-month accounting period (T).
Record the nominal load capacity of the dry-cleaning machine (S).
Apply the following equation:

$$\text{Emission rate (g/kg)} = Q = \frac{U \times 1\,000}{T \times S}$$

- Record the total weight of work processed during the 12-month accounting period (R).
Apply the following equation:

$$\text{Emission rate (g/kg)} = Q = \frac{U \times 1\,000}{R}$$

You will find it easier to provide this annual data if you keep the same records on a monthly basis. Your weekly data sheets used to monitor efficiency are a very useful starting point for this information. You can adapt the form in Appendix 2 for these internal records by replacing 'year' with 'month' in the column headings.

Compare your emission rate with the limit of 20 grams of solvent per kg of work processed. This will indicate both the efficiency of your current solvent use and the degree of improvement that you need to make.

There are definite advantages to keeping long-term records of solvent use:

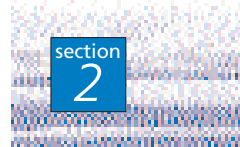
- they will help you to build up a history of your firm's solvent performance;
- they will highlight areas of potential concern and excessive solvent use;
- they will result in reduced solvent consumption, smaller solvent purchases and cash savings.

2.2 IMPROVING YOUR EQUIPMENT AND PROCEDURES

You can reduce your use of solvent by a combination of good machine/equipment operation, regular maintenance, and attention to issues such as solvent delivery procedure. Guidelines on these and other issues are set out in Sections 3 - 5.

You may already be observing these guidelines as a matter of course. If you are not, you may need to make significant changes in your working practices. In this case:

- List the changes that you need to make in order of importance.
- Draw up a work plan so that the key changes can be introduced stage by stage.
- Prepare simple written procedures for all processes that involve the handling or use of solvents. Make sure that these highlight ways of reducing solvent loss - by avoiding spillage, over-use, poor housekeeping, etc.
- Display summaries of these handling/processing procedures on the relevant machines for easy reference.



2.3 THE VALUE OF TRAINING

Good equipment and installation are important, but you will make real improvements in your solvent performance and reduce your solvent costs only if staff operate and maintain that equipment correctly. You should, therefore, make sure that:

- all staff are aware of the company's goals in relation to solvent consumption and of the associated safety issues;
- all staff are fully trained in every aspect of machine operation and solvent handling - ie they must know **what** to do;
- all staff understand **why** specific procedures are to be followed;
- every **new** member of staff is properly trained on arrival so that they do their job efficiently and safely.

You should provide the same level of resources and support for training staff to minimise solvent use as you provide for basic health and safety training. The information provided in the following Sections will help you. It is arranged in a logical way so that staff can be trained in the key points.

Without this training, and however enthusiastic your staff may be about using solvent efficiently, the results will never be as good as they might be. However, if all your staff are trained to 'get it right first time', your company will benefit, not only in terms of solvent consumption and expenditure, but also in respect of energy efficiency, solvent processing requirements and customer satisfaction.

2.4 TARGETS AND PERFORMANCE REVIEWS

Set realistic but challenging targets for solvent reduction at the beginning of the period (be it a month or year). In general terms, if you follow the recommendations on the day-to-day operation, maintenance, etc contained in this Guide, you should be able to increase by at least 10% the amount of work processed per litre of solvent used.

Make sure all your staff know what target has been set. Involve your staff by emphasising the part that they can play in reducing solvent use.

At the end of the period, review the progress made and make sure your staff know what has been achieved. Prepare graphs that show the changes in solvent use and the associated cost savings.

Set new targets for the following period.



This Section looks at how your approach to day-to-day issues such as the delivery and storage of solvent and the operation of dry-cleaning machines can influence your solvent use.

3.1 SOLVENT DELIVERY

Approximately one-third of dry-cleaning operators have solvent delivered by tanker into a storage tank. If you fall into this category of operator, you can **minimise** the possibility of dangerous and **costly solvent spillages** in several ways:

- Make sure that every storage tank is fitted with a reliable means of measuring its contents - preferably a dipstick. Dipstick openings should have a screw-on cap. Make sure this is in place before a solvent delivery starts.
- Check that the storage tank has sufficient room for the quantity of solvent being delivered. Overfilling can result in a major loss.
- Check that all valves/taps are set properly to receive the solvent.
- Wherever possible, make sure that storage tanks are positioned so that the delivery tanker can approach the filling point as closely as is consistent with safety.
- Make sure that all filling and coupling points are approximately one metre above ground level and have a diameter of 50 mm. Wherever possible, site them so that the flexible delivery hoses from delivery vehicles do not have to pass through doors or windows. Make sure that indoor storage tanks are always coupled to the delivery vehicle using a direct screw connection.
- Make sure that any extended filling pipe is capped off and provided with a valve at the coupling points. The filling pipe should be self-draining. If this is not possible, make safe provision for draining it.

You can also avoid solvent waste by making sure that all storage tanks and their delivery points are clearly labelled with the name of the solvent to be delivered. This should prevent the accidental mixing of solvents with fuel oil or other chemicals. If a wrong delivery is made, or you suspect one has been made, contact the supplier for advice. **Remember that it is dangerous to operate a boiler if the fuel has been contaminated with solvent.**

For reasons of safety, make sure that the vapour displaced when solvent is delivered to a storage tank is not discharged indoors.

3.2 SOLVENT STORAGE

If you store solvent, in whatever quantities, you can ensure safety and minimise solvent loss by following simple rules:

- Make sure that all your solvent storage vessels and their associated pipework are of sound construction, properly installed and suitable for the purpose for which they are intended. Whenever you have a delivery, inspect them externally for corrosion, mechanical damage and leakage.

- Check that all your storage vessels and their associated pipework are of the material specified by the solvent supplier. In the case of perc, this material should be galvanised mild steel or the appropriate grade of stainless steel. **Plain mild steel storage tanks are not suitable.**
- Make sure all your storage vessels are clearly labelled to show contents, capacities, hazards, precautions and delivery procedures.
- Do not store perc in clear polythene containers. Pigmented (usually black) high density polythene containers are acceptable.
- Because of their high density, **never store dry-cleaning solvents in tanks designed for water or fuel oil.**
- **Never store solvent near gas-fired driers, boilers, electric fires or other sources of heat.**
- Do not store perc in conditions of bright light. Storage vessels should be sited under cover in a cool, dry place with adequate ventilation - preferably in the open air.
- As well as using catchment trays, surround your solvent storage area with bund walls. This will prevent any discharge to groundwater if solvent spills do occur.
- Remember that security is important in limiting solvent loss. Make sure that you limit access to authorised staff only.
- If your storage tank has to be sited indoors, make sure that:
 - there is sufficient ventilation to limit the exposure of staff to solvent vapour if leakages or spillages do occur;
 - the tank is fitted with a permanent, rigid vent pipe with an internal diameter of at least 50 mm;
 - the vent pipe does not contain any valve or other obstruction;
 - the end of the vent pipe is in the open air, in a position where the discharged solvent vapour cannot enter any building or cause a nuisance;
 - the end of the vent pipe is protected to prevent the entry of rain or other unwanted matter.
- Install storage vessels in underground rooms only when you have considered all other options; special requirements apply in such cases.

3.3 SOLVENT TRANSFER TO MACHINES

Wherever possible, transfer solvent from the storage tanks to your dry-cleaning machine under gravity, via permanent metal (not plastic) pipes.

Where you have to pump the solvent, make sure that the pump is suitable for use with perc. All joints, seals, valves and fittings must be solvent-resistant. Install self-priming pumps above the top of the storage tank. Make sure that they have isolating valves to minimise any hazard resulting from a leaking gland. Alternatively, use a glandless pump.

Where the flow of solvent to the machine is controlled by a valve or pump switch, make sure that the operator can see the machine tank sight glass from the control point. For safety reasons, the operator must remain in place during the transfer of solvent to the machine. Make sure that the control switch is of the type that returns to the 'closed' or 'off' position when it is released. The flow of solvent will then cease if the operator leaves his/her post.

Never transport solvent in open-top containers - it is too easy for spills to occur. All containers must remain sealed until they are required, and should be resealed after use.

3.4 WATER SUPPLIES

Make sure that you have a reliable supply of chilled water. This is essential if you are to operate your dry-cleaning machines efficiently and safely. Water can be provided via either a storage tank or a cooling tower. If you need advice, contact your local water company (water authority in Scotland).

Remember that any wet cooling unit must be registered with the local authority under the *Notification of Cooling Towers and Evaporative Condensers Regulations 1992 (Legionnaire's Disease)*.

Clean and maintain your water cooling units regularly, and make sure that you take appropriate measures to prevent contamination of the water supply.

Provide adequate insulation:

- to prevent your water pipes freezing;
- to keep the chilled water cold to maintain efficiency of operation;
- to prevent your operators and other staff coming into contact with steam pipework and other hot surfaces.

3.5 MACHINE OPERATION

Your dry-cleaning machine(s) will operate with maximum efficiency and minimum cost if you follow the basic guidance set out in the manufacturer's handbook. This Section takes you through the daily procedures.

3.5.1 General

The best way of making sure that your dry-cleaning machines are operated safely and with the minimum amount of solvent is to train your staff properly. From a health and safety point of view, the greatest risk associated with operating a dry-cleaning machine is exposure of the operator or other people to solvent vapour. Make sure that your staff are trained to avoid spillage, check for and cure leaks, and avoid handling poorly-dried loads to reduce this risk, minimise your use of solvent and avoid excessive solvent costs.

You should also have an emergency procedure for responding to any leaks or spillages. This may include the use of respiratory protective equipment.

Whenever you operate or service a dry-cleaning machine, make sure that there is a second person on the premises throughout.

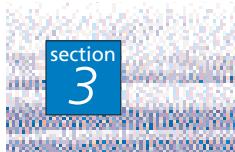
3.5.2 Before starting the machine

Before you or your staff begin to operate a dry-cleaning machine that has been shut down, you/they should take the following steps in the order given:

- Make sure that the general ventilation system is operating in the vicinity of the machine.
- Switch on the electricity supply to the machine.
- If compressed air is used, check that it is turned on and at the correct pressure.
- Check that the cooling water is circulating and/or that the refrigeration cooling system is operating. Cooling water should be supplied at the temperature, pressure and flow rate specified by the machine manufacturer.
- Check that each tank in the machine contains the correct volume of solvent.

- Check that the dust bag/lint filter and the button trap are clean. A blocked dust bag/lint filter will slow the drying process. A blocked button trap will hinder solvent drainage and the high-speed extraction process.
- Check that the loading door, button-trap lid, still door and dust bag/lint filter door are properly closed.
- Open the steam valve partially at first. Then open it fully and check that the machine has reached its correct operating steam pressure.
- Before cleaning the first load, operate the machine on dry/deodorise for a few minutes. This will condense any build-up of solvent vapour. Do not open any of the machine's access doors until this has been done.
- Check that all control thermostats and safety cut-outs are correctly set or marked for the solvent to be used.

If you find a fault during any of these checks, you MUST put it right before you start up the machine.



3.5.3 Loading/unloading and operating the machine

To minimise the amount of solvent used by the machine, follow these operating procedures, particularly during loading and unloading:

- Sort the work correctly into appropriate load types and record the weight.
- Do not use excessive 'spotting' solvent prior to loading.
- Take the load to the machine before opening the door.
- Underload the machine when cleaning heavy articles such as blankets and continental quilts. This will ensure efficient cleaning and drying and effective solvent recovery.
- Do **not** underload the machine when cleaning normal items. Remember that solvent consumption is the same for a small load as it is for a full load.
- Always avoid overloading the machine. Overloading results in inefficient drying and a reduced level of solvent recovery.
- Once you have started the machine, do not open the loading door until the entire cleaning cycle is complete. Do not attempt to put items into the machine when it is part-way through a cycle. Ideally, you should make sure that an interlock is fitted to the loading door to prevent this practice.



3.5.4 Adding solvent to the machine

Observe the following rules when you add solvent to the machine. This will ensure that you minimise solvent loss or spillage and limit the risk of other people being exposed to solvent or solvent vapour.

- Make sure that the ventilation in the vicinity of the machine is operating.
- Add solvent to the machine only when it is not operating.
- Make sure that the tank is large enough to take the amount of solvent being added.

Where there is a pipeline linking the solvent storage vessel with the machine:

- Take care not to overfill the tank.
- Remain beside the flow control switch or valve throughout the solvent filling process. Make sure that the tank contents gauge is visible from this point.

Where solvent has to be carried to the machine:

- Reduce the risk of spillage by using a labelled container with a close-fitting lid. **Never use open buckets.**
- Completely empty a five-litre container into the machine by placing the closed container in the cage, removing the cap and inverting the container. Then replace the cap.

Solvent safety data sheets are available from suppliers and must be kept with the machine, eg with the maintenance manual.

3.5.5 Closing down the machine

If you follow a fixed routine for closing down a dry-cleaning machine you will reduce the risk of releasing solvent vapour. For any machine, particularly one that uses a refrigerated recovery system, follow the routine given by the machine manufacturer.

The following general procedures should ensure a safe closing-down operation:

- check that distillation has finished;
- check that the loading door, button-trap lid, still door and dust bag/lint filter door are properly closed;
- turn off the steam supply and wait for the machine to cool;
- switch off the electricity supply to the machine;
- turn off the cooling water and/or the refrigerated cooling system in the way described by the machine manufacturer's instructions;
- turn off the compressed air;
- switch off the ventilation in the vicinity of the machine unless it is still required.

Note: Machines that incorporate overnight distillation facilities are subject to special requirements, and reference should be made to the relevant machine manufacturer's instructions.

Typical requirements are:

- clean the button trap and lint filter;
- check that the loading door, button-trap lid, still door and dust bag/lint filter door are properly closed;
- follow the correct distillation procedure (you may have to leave the electricity or water switched on).

Next morning, follow the machine manufacturer's instructions for still-cleaning and start-up.

3.6 DISPOSING OF WASTE SOLVENT

You must dispose of the residues from stills via a licensed waste contractor and **never** via drains, washbasins or WCs. Most machine manufacturers give very specific instructions for the changing and disposal of used filter cartridges. General details are given in Section 5.3.6.

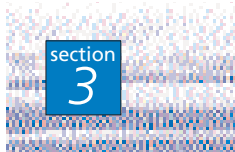
3.7 DEALING WITH SOLVENT SPILLS

If there is a solvent spillage, you must take the appropriate emergency precautions.

To minimise solvent losses and their associated costs, you should recover the solvent safely and return it to the machine:

- Pump any solvent collected in the spillage tray back to the machine.
- Where there is no spillage tray, recover the solvent using a suitable absorbent blanket or other cloth. Then clean this blanket or cloth in the dry-cleaning machine to recover the absorbed solvent.

Make sure that the staff who recover spilt solvent wear appropriate safety equipment as indicated by the supplier's safety data sheet. The equipment should consist of impervious gloves and footwear, plus a respirator with organic vapour cartridges.



There are certain equipment considerations that are important if you are to:

- keep the manual handling of solvent to a minimum;
- minimise solvent losses from the machine and storage tanks;
- provide enough ventilation so that the concentration of solvent vapour in any occupied area remains well below the permitted exposure level for staff.

4.1 IMPORTANT DESIGN FEATURES

The most important machine design features can be summarised as follows:

- Any new machine you install should be of the closed-circuit type or have an equivalent performance.
- Your machine loading door must be fitted with a device that:
 - prevents you from starting the machine unless the door is properly closed;
 - stops you from re-opening the door until the machine cycle has finished and the cage has stopped rotating.

This will ensure that no solvent (liquid or vapour) is lost via an open door during the dry-cleaning cycle. It also prevents anyone gaining access to the moving cage.

- Your machine should shut down automatically if the still, button trap or lint filter doors are not properly closed.
- To eliminate the risk of solvent decomposition - and therefore loss - the machine still must have good temperature control, with the heat source automatically switching off at the end of the distillation process.
- The machine should have a minimum of two solvent tanks - one to act as a working tank and the other to contain distilled solvent.
- The machine should have a spillage tray.

In addition, new machines should be CE marked to conform to European standards, see EN ISO 8230 *Safety Requirements for Dry-cleaning Machines using Perchloroethylene*. For further guidance on this, contact the British Standards Institution (Tel: 0181 996 9000) or the Health & Safety Executive's Infoline (Tel: 0541 545500).

4.2 INSTALLATION

Fitting and installing dry-cleaning equipment requires both special tools and technical skill. Make sure that you buy only from suppliers who are experts in this work and who have properly qualified engineers with the relevant specialist training. If gas installation work is required, make sure that a competent fitter is used, preferably one who is CORGI registered.

It is advisable to model your installation procedures on the Health, Safety and Environment Management Guidelines published by the Textiles Services Association Ltd (Tel: 0181 863 7755).

To minimise your solvent loss and ensure safety, you should pay particular attention to the following:

- Make sure that the foundations can withstand the combined weight of machine and solvent during operation.

- Site the machine so that solvent vapours cannot contaminate the air used for boiler combustion, or come into contact with red-hot surfaces.
- Make sure that a solvent catchment trough is fitted to all new installations. This should be capable of containing the entire solvent content of the machine's largest tank (with an additional 10% safety margin) and will allow you to recover any solvent that is accidentally spilt. It will also prevent solvent entering a sewer, a drain or the ground.
- Make sure that spillage collectors are placed under containers used for storing solvent or solvent-contaminated waste.
- Make sure that all spillage collectors are made of suitable impervious and corrosion-proof materials and can be easily inspected.

4.3 PROCESS SELECTION

All dry-cleaning machines should have a set of automatic programme sequences. These should ensure that:

- work is cleaned properly first time round;
- the solvent remains in good condition;
- solvent consumption and cost is minimised.

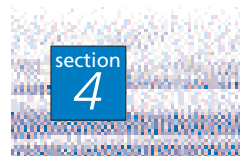
Make sure that every automatic cycle ends with a drying phase before the cage door can be opened. In each case, the drying phase should either incorporate automatic dryness detection or be selected to reflect the speed of drying of the work - thick items, for example, require longer drying periods. This will help to minimise solvent loss.

Make sure that none of your programmes either require or allow the cage door to be opened in mid-cycle. Again, this will minimise solvent loss.

Vary the sequence of programmes used. This will avoid the repeated transfer of solvent to the still which could cause overfilling, 'black-over' or solvent spillage.

Make sure that the programme sequence does not allow the solvent in the still to become excessively concentrated with additives. Additives may cause foaming or other problems that can result in the unintentional release of solvent.

Always opt for automatic control rather than manual control. This reduces the possibility of human error and ensures that each step in the cleaning cycle occurs in the correct order.



Routine maintenance is essential to the efficient operation of a dry-cleaning machine. More specifically, it will help you to:

- optimise your machine's performance;
- detect solvent leaks and other problems at an early stage, thereby minimising solvent loss;
- minimise your consumption of all resources, including solvent and energy, thereby reducing costs.

As explained in Environmental Performance Guide (EG39) *Perchloroethylene Consumption in the Dry-cleaning Industry* (available free of charge through the Environmental Helpline on 0800 585794), you should pay close attention to the maintenance recommendations and schedules provided by the manufacturer of your machines. You will find that some of the work can be done by your own staff. However, you should employ competent, trained engineers to carry out major services at the recommended time intervals.

Remember that a well-maintained older machine may perform better than a newer one that is poorly maintained.

5.1 CHECKING FOR SOLVENT LEAKS

Leaks that allow solvent liquid or vapour to escape from the dry-cleaning machine and its associated storage tanks are one of the main causes of solvent loss. You should therefore leak-test all joints and seals on both liquid and vapour circuits every month. It is also good practice to check for leaks on a daily basis.

You should carry out leak-tests on the following:

- | | |
|---------------------------------|--|
| ■ cage door gasket; | ■ vapour line; |
| ■ lint filter; | ■ fresh air damper (where applicable); |
| ■ fan housing inspection hatch; | ■ still doors; |
| ■ recovery head; | ■ filter seals; |
| ■ button-trap lid; | ■ filter dump valve; |
| ■ main bearing seal; | ■ solvent valves; |
| ■ heating coil battery; | ■ solvent tank sight glasses; |
| ■ cooling coil battery; | ■ solvent pipe flanges. |
| ■ air duct inspection hatch; | |

Suitable leak-detection devices such as stain tubes, electronic detection instruments and the leak-detection lamps used by refrigeration engineers are readily available. If you are testing using a halide lamp and you obtain a positive result, take care to avoid breathing in the fumes produced.

Although vapour leaks can be detected during the early part of the dry-cleaning process, they are more obvious during the early stages of the drying cycle, and it is advisable to test for them during this stage.

Once you have detected a leak you should repair it as soon as possible. This will help to minimise your solvent losses and costs.



5.2 OTHER GENERAL MAINTENANCE CHECKS

- Regularly clean and check all drying and still thermostats to make sure that they are operating correctly and at the required temperatures.
- Test the level controls in the drum and the still to make sure that they are operating properly and at the correct level.
- Test the still pressure-relief device to make sure that it provides the necessary relief at the correct pressure and that it discharges safely within the machine.
- Check that the drum drains correctly and that there are no blockages to slow the drying process.
- Make sure that lint cannot bypass the lint filter and block the drying circuit, causing poor drying.
- Make sure that debris cannot pass the button trap and cause a pump blockage, thereby slowing down the rate of high-speed extraction.

5.3 MAINTAINING SPECIFIC COMPONENTS

5.3.1 Door seals

Make sure that all door seals, ie those on the front of the machine, on the button-trap, on the lint filter, on the still and on the water separator, are wiped daily to keep them clean.

Replace access door seals at least once a year - more often if you find a leak - and always keep a supply of replacement seals in stock.

Record all door-seal repairs in the maintenance file.

5.3.2 Button trap

Clean the metal sieve in the button-trap after the drying cycle, when the air in the button trap contains less solvent. This will minimise the amount of solvent vapour escaping into the dry-cleaning room as the button-trap lid is opened. Remember that, on most machines, you can remove the sieve for easier cleaning - but make sure the machine is switched off first.

5.3.3 Lint filter

The lint that is carried along in the air during the drying cycle is caught in the lint filter, forming a thicker and thicker layer over the course of a working day. This slows down the flow of drying air and reduces the rate of drying.

You can prevent this build-up of lint by cleaning out the lint filter regularly - ideally twice every working day. You should clean the lint filter door seal at the same time and close the door properly afterwards to prevent any solvent leakage.

5.3.4 Water separator

For environmental and operational reasons it is essential to prevent droplets of solvent being released with the contact water or droplets of water entering the distilled solvent tank. You should therefore drain and clean the water separator regularly (where possible at two-weekly intervals). Refill according to the manufacturer's instructions. This will help to minimise solvent loss.

You should also drain excess water daily when the machine is not operating. Check this liquid for signs of solvent - visible as a separate layer - and take appropriate action if necessary. **Operators must prevent any solvent discharge from the separator to drain.**

5.3.5 Solvent pump

The solvent pump in your machine will be less efficient if the solvent contains coarse particles of lint. If a button, needle or other object finds its way into the pump, it will damage the pump's internal workings and sometimes cause a complete breakdown.

If you do need to repair the solvent pump or install a new one, make sure you limit the opportunities for solvent loss by:

- shutting off the valves closest to the pump to prevent solvent running out of the button trap and pipes (to do this by hand, you will usually need to shut off the compressed air inlet valve and release pressure via the surface unit);
- testing the pump for leaks once the joints have been tightened, either by completing an unfinished load or by circulating solvent around the system.

Always make sure that any electrical leads to the pump are disconnected by a competent person and that the pump itself is repaired by a pump specialist.

5.3.6 Filters

Filter cartridges need to be changed when the pressure reaches the maximum specified by the manufacturer (normally 1.5 bar or 20 psi). To minimise solvent loss during this procedure:

- Check whether there is room in the still for the filter contents.
- Open the filter drain outlet to remove the filter contents.
- Leave the spent filter cartridge(s) in the machine overnight to drain.
- Remove the spent filter cartridge(s), place in a polythene bag or container and transfer to the cage of the dry-cleaning machine. Remove the bag or container and then dry the cartridge(s) according to machine operating instructions (do not tumble dry). This will allow you to recover any remaining solvent.
- Place the dry cartridge(s) in a polythene bag or similar and seal. Remove from the premises.
- Insert the new cartridge(s), making sure that the spacers and washers are fitted correctly.
- Seal the filter housing.
- Close the filter drain outlet.

5.3.7 Still

You should clean your stills at least once a week and more frequently in the case of busy units. This should:

- prevent the accumulation in the still of excessive amounts of residue;
- reduce solvent consumption and operational costs;
- reduce the risk of operational problems and still boil-over.

Always follow the manufacturer's instructions for still cleaning. The main procedures are as follows:

- Empty the still (new machines should have automatic still-emptying systems). Open the still door afterwards with caution, only partially releasing the locking mechanism so that the door can be reclosed quickly if necessary. If solvent is still present in large quantities, find out why, and carry out redistillation before cleaning. If in doubt, consult the engineer.
- Dry the residue in the still in accordance with the manufacturer's instructions or for a minimum of one hour. This will maximise solvent recovery and minimise the amount of solvent retained in the residue. No fresh solvent should enter the still chamber during this process.
- When the still is cold, eg first thing in the morning, remove the residue. Where the still door is close to the floor, you may need to scrape out the residue into a shallow tray. Wear impervious gloves and a cartridge respirator if there is any possibility of exposure to solvent.

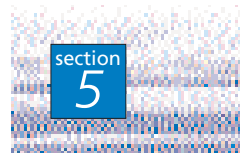
- Transfer the residue to a covered container for safe removal. Do not leave it uncovered within the building.
- Close the still door, first making sure that the sealing faces are clean and undamaged.
- Close any drain valves.
- Visually check the still door for leaks during the first cycle.

You should also check the still condenser to make sure that it is clean and effective. This is essential to the sub-cooling (to below 30°C) of the condensing solvent which helps to avoid solvent vapour loss and unduly harsh dry-cleaning.

5.3.8 Recovery condensers

Where a machine incorporates an air-cooled refrigeration system, the condenser fins must be kept clean in accordance with the machine manufacturer's instructions. This will ensure that the system remains efficient. Take particular care to ensure that refrigeration pipework is not accidentally fractured or damaged. The main tasks are as follows:

- Use a vacuum cleaner to clean the lint filter every three loads or as specified by the manufacturer.
- Every six months, remove and service the refrigeration and water coils. This will ensure efficient solvent recovery. Record this work in the maintenance manual.
- Clean the refrigerated recovery unit and top up with refrigerant if appropriate. Check refrigerant pressure and adjust as necessary.
- Examine the recovery head to make sure that the cold surfaces are clean, air traps are clear and solvent droplets can drain away freely. Effective chilling of the cold surfaces requires the provision of water at the correct pressure, temperature and flow (for water-cooled machines) and refrigerant at the correct pressure and temperature (for refrigerated machines).



5.3.9 Carbon adsorption units

If your machine incorporates a carbon adsorption solvent recovery system, make sure that you operate and maintain it in accordance with the manufacturer's instructions. Check the unit regularly to make sure that the bed is dry and uniform, with no channelling or bypassing and no blockage with fine carbon powder. Periodically examine the bed's 'housing' for corrosion, and repair as necessary.

There are several conditions that can, together or individually, adversely affect the performance of a carbon adsorption unit and lead to low levels of solvent recovery:

- There may be an abnormal level of dampness in the carbon. There are two main causes of this:
 - large quantities of unsaturated water vapour in the activated carbon bed at the end of the regeneration process;
 - a leaking steam valve that allows water or superheated steam into the carbon bed during the adsorption phase.

In the first instance, remove the water vapour as quickly as possible, preferably by installing a fan to blow clean air through the bed. Allow enough drying time to make sure that the bed is thoroughly dry.

In the second instance, first check the condition of the seals on the steam valves. These are subject to wear and may need to be replaced. A pipe that remains hot, even when the steam is turned off, can indicate a defective valve. Then carry out a so-called 'general regeneration'. This involves steam-treating the carbon bed for one hour using steam of the correct quality, then drying the bed for at least one hour. You will not solve the initial problem unless you allow sufficient time for both these processes.

In both cases take positive action to identify the cause of damp carbon and put it right.

- The carbon may have become overloaded because it has passed its regeneration point. The carbon in the filter does not last for ever and so some carbon replacement is necessary. Normally, it is sufficient to carry out this operation once a year and replace only the amount of carbon lost. To do this, you must remove the surface dust and top up the bed with fresh carbon granules to the correct level.
- There may be a reduction in steam pressure caused, for example, by incorrect adjustment of a hand-operated valve or by a clogged lint filter.
- There may be a saturated steam condition caused, for example, by an incorrectly operating condensate separator or by poor insulation of the pipework.

5.4 PLANNED MAINTENANCE PROGRAMME

A suggested planned maintenance programme to be carried out at one-, four-, six- and twelve-monthly intervals is shown in Appendix 3. It should be used in conjunction with the equipment manufacturer's suggested maintenance programme.

5.5 SAFETY DURING MAINTENANCE, SERVICING AND REPAIR

5.5.1 Training of maintenance personnel

Servicing and maintenance may be carried out by an operator or proprietor or by specialist outside engineers. You must make sure that whoever undertakes this work is trained and competent, and has read and understood the machine manufacturer's manual and solvent precaution instructions.

Safe working procedures must always be applied.

5.5.2 Ventilation

Maintaining and repairing dry-cleaning machines may result in short-term, localised releases of solvent vapour. You must therefore make sure that the machine area ventilation system operates effectively during servicing and maintenance operations. You must also ensure that there is sufficient overall ventilation to provide a safe working environment and to prevent the accumulation of harmful gases.

5.5.3 Isolating the machine

Before you begin to maintain or repair a dry-cleaning machine, take the following steps to isolate potential sources of danger:

- Turn off the heat source to the dry-cleaning machine and allow the machine to cool before the cooling systems are turned off.
- Isolate the machine from the electrical supply and make sure the isolator is locked off, except when power is required for testing purposes. If you cannot lock off the isolator, remove the circuit fuses from the isolator box. At the same time, make sure there is adequate ventilation.
- Fix a 'Danger - Person at Work' sign to both the machine and the isolator switch or fuse box before work commences.

5.5.4 Entry into confined spaces

It should not normally be necessary for any person to enter a confined space that contains, or is likely to contain, solvent fumes. There may, however, be a few occasions, for instance during the repair of larger dry-cleaning machines, when whole-body entry cannot be avoided. In these circumstances make sure that the requirements of Section 30 of the Factories Act are followed. These cover the removal of solvent, testing and certification of the atmosphere, and the provision and use of breathing apparatus, lifelines and reviving apparatus.

Identify **now** any plant that may have to be entered during future maintenance work (eg base tanks on larger machines). Draw up suitable instructions on safe systems of working (including written permit to work systems) well before the need to enter arises.

5.5.5 Other conditions for safe working

- Make sure that the floor around the machine is, as far as possible, kept clean and clear of obstructions.
- Do not use cloths soaked in a dry-cleaning solvent to clean any machine surface. The oil/filter bottles fitted to compressed air systems are particularly liable to be damaged by solvent and may explode.
- Take care to avoid accidental contact with any accessible hot part.
- Make sure that a second competent person is available to provide assistance should something unforeseen happen.

5.5.6 Restarting the machine after maintenance or repair

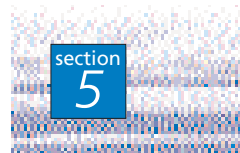
When reconnecting steam and water services after servicing, maintenance or repair, follow the steps set out below in the order given:

- **Water** – partially open water supply valves and check for leaks before restoring normal operating flows.
- **Steam** – check that the steam pressure to the machine is at the level recommended by the machine manufacturer. Partially open steam supply valves and check for leaks before progressively opening to normal settings.

Make sure that all machine guards are in the correct position and properly secured once maintenance has been completed.

After completing servicing, maintenance or repair and before restoring the machine to full working order, it is advisable to carry out at least one full cycle, preferably in the presence of the operator, before restoring the machine to normal service. Each test cycle should include checks to confirm that:

- all safety interlocks operate;
- there are no leaks of solvent (liquid or vapour), steam, water or compressed air;
- all motors rotate in the correct direction;
- the machine fan does not blow solvent vapour into the working area when the machine door is open;
- the load is dried properly in the normal drying time.



- ☑ Identify the opportunities for improving solvent use and reducing your operating costs. Remember that these opportunities can occur at many stages in the dry-cleaning cycle:
 - equipment design and installation;
 - solvent storage and handling;
 - selecting a dry-cleaning process;
 - machine operating practices;
 - machine maintenance;
 - solvent recovery.

- ☑ Make solvent efficiency the main subject of a Solvent Management Plan. Use your weekly records to generate:
 - monthly consumption figures;
 - a graph showing consumption over time (you can use this as a basis for future action);
 - workroom display material.

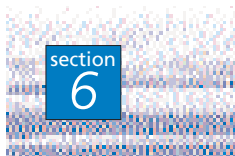
Make sure that you always relate your solvent consumption to the amount of work processed.

- ☑ Make sure that your operating staff are trained to handle and use solvents correctly. This will help to avoid spillages and minimise solvent emission levels.

- ☑ Make **all** your staff aware of the reasons - environmental and financial - for reducing solvent consumption.

- ☑ Check that your dry-cleaning machines are properly designed and correctly installed.

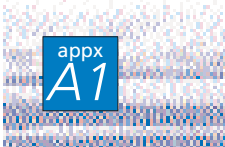
- ☑ Discuss the most appropriate dry-cleaning processes for each machine with your detergent supplier. This will help to minimise solvent distillation and use, and will reduce the need for recleaning. Make sure that the processes selected are pre-programmed into the control computer.
- ☑ If you need to buy new equipment, consider installing a modern, closed-circuit, fifth-generation machine that has integral carbon adsorption, automatic still pump-out and a user-friendly computer control system.
- ☑ Model your installation procedures on the Health, Safety and Environment Management Guidelines published by the Textile Services Association.
- ☑ Improve the solvent performance of existing less efficient, open-circuit machines by retrofitting a free-standing carbon adsorption unit and by paying close attention to your operating and maintenance procedures.
- ☑ Make sure that all machines are properly maintained under a planned maintenance schedule.
- ☑ Make sure that your maintenance staff are trained using both the Health, Safety and Environment Management Guidelines and the information provided in this Guide.
- ☑ Set realistic targets for reducing solvent use and check performance against these targets.
- ☑ Make sure that you recognise the efforts of your staff in reducing solvent consumption.
- ! Invest the savings that result from reduced solvent consumption in a high-interest deposit account - or take a holiday!



Appendix 1

WEEKLY SOLVENT USE

Week beginning Monday	Solvent volume in machine at beginning of week (litres)	Solvent added to machine during week (litres)	Solvent volume in machine at end of week (litres)	Solvent used during week (litres)	Weight of work processed during week (kg)	Weight of work per litre of solvent used, ie solvent performance (kg/litre)
	(A)	(B)	(C)	$(D = A + B - C)$	(E)	$(F = E/D)$





SOLVENT MANAGEMENT PLAN*

Year (Month)	Solvent stock at start of year (month) (kg)**	Solvent purchased during year (month) (kg)	Solvent stock at end of year (month) (kg)	Change in solvent stock level over year (month) (kg)	Solvent in waste sent for treatment or recovery during year (month) (kg)	Quantity of solvent emitted during year (month) (kg)	Number of loads processed during year (month)	Nominal load capacity of machine	Weight of work processed during year (month) (kg)	Quantity of solvent emitted per kg of work processed (g/kg)
	(Z)	(Y)	(X)	(W = X - Z)	(V)	(U = Y - W - V)	(T)	(S)	(R)	(Q)***

* Ref. Article 8 (4) of the draft VOC Directive

** To convert litres into kg, multiply by 1.6 if the solvent is perc

*** $Q = \frac{U \times 1\,000}{T \times S}$ or $\frac{U \times 1\,000}{R}$

PLANNED MAINTENANCE PROGRAMME

The following is a suggested planned maintenance programme to be carried out at one-, four-, six- and twelve-monthly intervals. It should be used in conjunction with the equipment manufacturer's suggested maintenance programme.

SUGGESTED PLANNED MAINTENANCE SCHEDULE

Carry out the following operations (checks, adjustments, corrections etc) using the maintenance manual for procedures. Put the date alongside each item on completion. Once all maintenance for the year has been completed, sign and date the sheet and file it in the health and safety manual.



EVERY MONTH

Task	Date completed
DRY-CLEANING MACHINE	
Check machine is secured to the ground	

EVERY FOUR MONTHS

Task	Date completed
DRY-CLEANING MACHINE	
Check still and oil level, clean sight glass	
Check safety seal	

EVERY SIX MONTHS

Task	Date completed
DRY-CLEANING MACHINE	
Examine filter and breather	
Check fan housing	
Check machine cooler	
Check recovery head for corrosion	
Drain and clean water separator	
Check drain valve	
Check drain elbows	
General machine lubrication	
Check machine bearings	
Check belt tension and wear	
Check traps and strainers	
Check and clean base-tank pump	
Check button trap and lint build-up	
Check float switches	
Check flexible pipework	
Check solenoid valve	
Check safety interlocks	
Lubricate filter 'O' rings	
Check door seals	
Check separator to still hose	
Check vent pack	
Check filter drain canisters	
Check machine electrics	
Check machine operation	
Leak test machine	
Check refrigeration condenser	
Check condition of refrigeration plant	
Check operation of refrigeration plant	
BOILER PLANT	
Check water side controls	
Check water level gauge glasses	
Check blowdown systems	
Check alarms and pump controls	
Test gas or flame failure device	
Check oil line cut-off device	
Check safety valve	
Check general condition of boiler plant	
Check condensate tanks	
Witness safety check by boiler operation	
Check boiler flue	

Task	Date completed	
ANCILLARY PLANT - GENERAL CONDITION CHECK		
Solvent recovery unit		
Water softener		
Presses		
Steam air finishers		
Puff iron		
Steam vacuum table		
Spotting table		
Iron table and hoses		
Shirt unit		
Rotary cabinet		
Washing machine		
Tumble drier		
Vacuum pump		
Conveyor		
Ventilation system		
Fire extinguishers		
Alarms and sign general register		
Electrical installation		
COMPRESSOR		
Check safety valve		
Check air inlet filter		
Check or refill oil as necessary		
Check general condition of air lines		
COOLING SYSTEM		
Clean strainers and air inlet grills		
Check settings and operation of the temperature and pressure control valves		
Check and lubricate fan bearings		
Check tower fan belt and tension		
Check general condition and operation		
GENERAL		
Check emergency lighting		
Check operation of sump pumps		
Check operation of earth leakage circuit breakers		
CONTRACTORS		
Check recent work carried out		

EVERY TWELVE MONTHS

Task	Date completed	
DRY-CLEANING MACHINE		
Examine base tank and sight glass		
Examine distilled storage tank		
Remove and clean air heaters (electrical)		
BOILER PLANT		
Statutory thorough examination		
Check scale build-up on electric elements		
Service burner		
Carry out efficiency test		
COMPRESSOR		
Statutory thorough inspection		



The Environmental Technology Best Practice Programme is a joint Department of Trade and Industry and Department of the Environment initiative. It is managed by AEA Technology plc through ETSU and the National Environmental Technology Centre.

The Programme offers free advice and information for UK businesses and promotes environmental practices that:

- **increase profits for UK industry and commerce;**
- **reduce waste and pollution at source.**

To find out more about the Programme please call the Environmental Helpline on freephone 0800 585794. As well as giving information about the Programme, the Helpline has access to a wide range of environmental information. It offers free advice to UK businesses on technical matters, environmental legislation, conferences and promotional seminars. For smaller companies, a free counselling service may be offered at the discretion of the Helpline Manager.

FOR FURTHER INFORMATION, PLEASE CONTACT THE ENVIRONMENTAL HELPLINE

0800 585794

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World wide web: <http://www.etsu.com/ETBPP/>

